# ADDENDUM

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This issue of *Perspectives on Language and Literacy* offers readers guidance on how to evaluate reading interventions and instructional methods to determine their effectiveness. See this issue's Theme Editor's Introduction on page 7 for more information about the issue, its purpose, and the context of the article that follows.

In the article that follows, Caroline Bowen provides an overview of the origin for the Arrowsmith Program™ and highlights how proponents rely on technical jargon about the brain to give the method a veneer of scientific credibility when none is warranted. Bowen gives an overview of the program components and explains how the Arrowsmith Program has become especially popular in Canada. Bowen also describes a revealing account of her experience developing and submitting a student profile at the Arrowsmith Program's website.

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# Independent Research and the Arrowsmith Program™

by Caroline Bowen

Initiated as a tutoring service in Toronto in the late 1970s by Canadian author, entrepreneur, lecturer, and program director Barbara Arrowsmith Young, The Arrowsmith Program™ (Arrowsmith™) is promoted as a remedial methodology for specific learning disabilities (SLD) based on neuroscience research and almost four decades' experience of administering its threefold system of "specific cognitive exercises." Arrowsmith™ emanated from its founder's interpretations of the work of Russian neuropsychologist A.R. Luria (1902–1977) in brain-function localization theory, neuroplasticity, veterans' recovery from traumatic brain injury (TBI), and investigations by American research psychologist Mark Rosenzweig (1922–2009), who demonstrated that neuroplasticity is lifelong. These interpretations are not supported by Luria's findings, though, and oversimplify Rosenzweig's research (see Alferink & Farmer-Dougan, 2010 for discussion of the misapplication, in education curricula, of neuroscience research). Referring to Luria's and Rosenzweig's work, in 1977–78 Arrowsmith Young fashioned a program of intensive, graduated, and strenuous "cognitive exercises," sometimes called "brain training," intended to remediate her own multiple, severe learning disabilities, which she claimed "changed her brain" when self-administered (Brainex Corporation, 2015a). As Castles and McArthur (2013) comment, the term brain training is somewhat tautological, as all learning happens in the brain. Arrowsmith Young's disabilities, aspects of which persist, included dyslexia and dyscalculia as well as difficulties with expressive language, "spatial reasoning," logic, "kinaesthetic perception," and incoordination (Arrowsmith Young, 2013).

An "academic exercise" is work, directly related to curricula, at a school, college, or university, that centers on studying, reasoning, and integrating new knowledge rather than on practical, technical, or underlying skills. For example, learning to read via a Structured Literacy approach is an academic exercise, directly concerned with denotatively teaching the subskills required for reading acquisition and related skills. Structured Literacy instruction incorporates "a strong core of highly explicit, systematic teaching of foundation skills such as decoding and spelling skills, as well as explicit teaching of other important components of literacy such as vocabulary, comprehension, and writing." (International Dyslexia Association, n.d.).

By contrast, Arrowsmith™ offers 19 categories of cognitive exercises directed toward "brain training." The exercises are unrelated, or at best, tenuously related to learning to read. Moreover, there is no enlightenment in the works of Luria or Rosenzweig as to the mechanisms whereby the exercises might impact literacy acquisition.

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Examples of the exercises, which increase in complexity as the student with SLD works through them, include: 1) Tracing and reproducing letters and numbers from English and other writing systems (e.g., Arabic), and symbols, with an eyepatch covering the left eye. The intent of this pencil-and-paper exercise is to target a skill Arrowsmith Young calls *Motor Symbol Sequencing* by making the right eye "work harder" (this is not an achievable goal). The exercise is done repeatedly for up to 30 minutes. This is claimed to stimulate the motor cortex in the left hemisphere, so facilitating improved "tracking" (for reading), more efficient binocular vision, and better responsiveness to visual cues. 2) *Memory for Information or Instructions* is addressed through having a student listen to the lyrics of a song many times, until they can repeat them from memory. The lyrics are adjusted to become increasingly challenging for the student to remember, as the exercise proceeds. This is said to remediate a deficit in the left temporal lobe. 3) The *Broca's Speech Pronunciation* exercise addresses students' tendencies for mispronunciation and to have small spoken lexicons. Students read, from a computer screen, randomly generated, multisyllabic nonwords (e.g., mantieric and similar sequences), with varying lexical stress; for example: MAN-tie-ric man-tie-RIC man-TIE-ric, over and over. This is intended to help with sound-symbol correspondence, enabling students to learn new words, pronounce words correctly, and to be able to talk and think simultaneously.

The next step in rolling out the program was *not* to circulate the exercises, operationalizing them by describing in detail their implementation, so that other adults might follow her example, or to allow independent researchers to develop evidence of effectiveness. Rather, Arrowsmith Young commercialized them in 1980 by founding a for-profit school for children with SLD aged six years plus (Grades 1 through 12), which

## Abbreviations

EBE: Evidence-based education
EBP: Evidence-based practice
SLD: Specific learning disability
TBI: Traumatic brain injury

they attend for three to four years in the care of trained Arrowsmith Program™ teachers. The program has since widened its scope to include youth and adults, too. "Volunteer advocates" are encouraged to promote Arrowsmith™ to school administrators and the general community. For example, an Advocacy Guidelines *(https://arrowsmithschool.org/advocacy-guidelines/)* document is provided, and brochures circulated, prompting parents and teachers to "learn more about advocating for the Arrowsmith program in your area" and explaining how to go about it.

The Arrowsmith School website read in March 2020, "The Arrowsmith Program is based on the philosophy that it is possible to treat specific learning difficulties by identifying and strengthening cognitive capacities." Other persuasive Arrowsmith™ websites (e.g., *www.eatonarrowsmith.com; https://barbaraarrowsmithyoung.com*) contain real and self-created "scientific" terminology, apparently to emphasize Arrowsmith's neuroscientific credentials. Clearly defined terms that are commonly used in bona fide neuroscience and related disciplines include brain-imaging, synapse, neuron, and neuroplasticity. The self-created terms found in the Arrowsmith™ materials include artefactual thinking, mental initiative, cognitive-curricular research, large scale brain networks, quantification sense, spatial reasoning, and targeted cognitive exercises.

## Neuroplasticity

Bishop (2013, p. 248) observed, "Essentially, saying the brain is plastic and not fixed boils down to saying that children can learn new things—hardly a remarkable finding." Nonetheless, many reading interventions and all-embracing "learning disorders" nostrums (explored in Bowen & Snow, 2017, pp. 220–255) carry overt or thinly disguised undertakings to "change your, or your child's brain" through "brain training." Arrowsmith Young claims to have changed her *own* brain so radically that she overcame serious learning problems, presenting her strategy as a scientific breakthrough-intervention that can be applied to others.

Neuroplasticity is an attested, complex, multidimensional, and primary property of the brain and the subject of extensive peer-reviewed research. Often comparatively limited in adults, it is the brain's capacity to reorganize itself by forming new neurons and neural networks in response to any combination of development, environmental change, new learning, new situations, sensory stimulation, damage, or dysfunction. Most active in infancy and childhood, neuroplasticity sees well-utilized connections or "synapses" between brain cells strengthening, and disused ones weakening or decaying. By changing neural connections and behavior, the brain can potentially compensate for the effects of injury (e.g., TBI or stroke), loss (e.g., adjusting to paraplegia or amputation or to losing an eye), conditions (e.g., hearing impairment) and disease (e.g., multiple sclerosis).

Less dramatically, but no less obviously, commonplace activities and experiences change our brains. For example, a good night's sleep, a hearty lunch after an energetic hike, mastering the butterfly stroke, consuming chocolate, reading an illuminating article, learning to pronounce "covfefe," or laughing helplessly at a friend's hilarious story change the brain. Brains adapt depending on how they are stimulated, but knowing this simple fact cannot inform teachers and other professionals how the brain should be stimulated (i.e., what exercises should be done) in order to rectify learning difficulties. There is no evidence or underlying theory to support claims that "cognitive exercises" or "brain training" can selectively target brain regions to improve performance and improve academic outcomes.

## A Mental Workout for the Brain

The Arrowsmith™ protocol, as described in the Arrowsmith School brochure (dated May 2018) comprises a suite of over 12,000 discrete levels of exercise, refined and updated once annually (at the end of each school year) for each student. The protocol entails: "written, visual and auditory" computer exercises that are asserted to target comprehension, face-recognition, landmark recognition, logic, numeracy, reading, reasoning, and visual memory for symbol patterns; auditory exercises that purportedly advance students' memory functions, oral and written expression, and vocabulary; and, pen and paper exercises claimed to build "the cognitive capacities" essential to developing the motoric skills needed for "mechanical aspects" of communicating nonverbally, executive functioning, organizing, planning, and writing. The intent of the exercises is to capitalize on neuroplasticity, by selectively strengthening the "weak cognitive capacities" underlying students' "learning dysfunctions." Deficits are thereby remediated across 19 localized areas of brain function (or dysfunction), specified and described in a nutshell, with no references to the scientific literature, by Arrowsmith proponents. At no point do students focus on reading in order to improve reading, or spelling in order to improve spelling, or on any other curriculum area—specified in the Structured Literacy definition (International Dyslexia Association, n.d.) above—in order to improve performance in that area.

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Scientific discourse, in Education, Medicine, Neuroanatomy, Neurophysiology, various branches of Psychology, Speech-Language Pathology, and related disciplines, does not support some of the dysfunctions Arrowsmith Young recognizes. These include: the Broca's speech pronunciation deficit—located in Broca's area—detrimental to articulation, vocabulary, and speaking-and-thinking concurrently; the auditory speech discrimination deficit— housed in the superior temporal lobe—blocking the ability to recognize rhyming words; the symbolic thinking deficit—situated in the prefrontal cortex—giving rise

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to a short attention span and limiting "mental initiative," and the "kinesthetic perception deficit"—positioned in the somatosensory area of the parietal lobe—causing ungainliness, a tendency to crash into objects, and sometimes manifesting as messy handwriting. According to Arrowsmith proponents, the exercises are analogous to a "workout": in this case a "mental workout for the brain" where "under-functioning areas are treated like weak muscles and are intensely stimulated through cognitive exercises."

Anecdotes from Arrowsmith™ proponents claim the method is successful for elementary school children, adolescents, and adults. They claim when used over three to four years, difficulties with attention, auditory memory, comprehension, dyslexia, logical reasoning, mathematics, problem-solving, processing speed, nonverbal learning, reading, visual memory, and writing are all improved.

### Specialized Schools and Self-contained Classrooms in Mainstream Schools

All treatment takes place within six specialized schools: five in Canada and one in the U.S., or in self-contained classes comprised only of children with the said "learning dysfunctions." Such classrooms have been established in more than 100 mainstream schools, internationally. Between 2005 and 2012, Howard Eaton opened four Eaton Arrowsmith Schools, which he owns and operates: three in British Columbia and one in Redmond, Washington. The Eaton Arrowsmith Schools solicit international enrollments, and students have come from Australia, Taiwan, the UK, and the U.S. International enrollments at Arrowsmith Young's Toronto and Peterborough campuses, owned and operated by her, have included students from Australia, the United Arab Emirates, and the U.S.

For school-aged students in the full-time program, mornings are spent in mathematics and English classes (two periods), with a student-to-teacher ratio of 7:1, while afternoons are devoted to six periods of the cognitive exercises. This means that the students do not have access to the regular school curriculum and attendant interaction with peers and teachers. Arrowsmith Young cautions that, "Upon completion of the program some students may require one to two years to gain experience using their newly strengthened cognitive capacities and some students may need tutoring initially to bring academic skills to grade level given their gaps in academic learning."

### The Arrowsmith Program™ Cognitive Profile Questionnaire

Over 30 minutes, the author carefully completed the Arrowsmith Program™ Cognitive Profile Questionnaire *(www.brainex.net/protoQuest/User.html)* as an "acquaintance" of "Pseudonym" (the name entered in the questionnaire), a real typically developing girl approaching her ninth birthday. Pseudo has age-typical literacy acquisition, has completed Year 3 in a New South Wales public school, and was to proceed to Year 4 in late January 2019.

Reflecting Pseudo's abilities, at 8;11 (years;months), the responses to survey items, from a choice of five, were most often marked as "not a problem" (e.g., for: "she has a tendency to bump into doorways, objects, or people"; "her handshake is weak"; "she is bullied"; and "her speech sounds slurred"), "sometimes" for several items (e.g., for: "she mispronounces words"; "she has trouble understanding someone with an accent", "she is teased"; and "she forgets instructions when she is distracted"), and "don't know" for six items (i.e., for: "she forgets what the teacher asked her to do for homework"; "she makes careless errors in mathematics"; "she has difficulty learning from her mistakes on her exams"; "she has particular difficulty learning phonetic based foreign languages"; "she is not worried in situations where she should be"; and "she has difficulty understanding relational formulas"). None of the items warranted responses of "most of the time" or "all the time."

Seven months previously, at 8;4, Pseudo *was* lagging behind her peers in reading but was a strong speller with a Peabody Picture Vocabulary Test percentile ranking of 92. From 8;5, she participated reluctantly, but conscientiously in 20 weeks of MultiLit, an intensive, robustly evidence-based literacy intervention program (Wheldall & Wheldall, 2014; Wheldall, Wheldall, Madelaine, Reynolds, & Arakelian, 2017). At 8;11, she was dismissed from MultiLit with literacy skills in the 68$^{th}$ to 77$^{th}$ percentiles, with intensive intervention now "not recommended." Pseudo is an articulate, confident, sociable, popular, trumpet-playing child, excelling in sports, dance, music, and gymnastics. She reads voraciously and is an enthusiastic "leader" among her peers. She performs at grade level or above across the curriculum, with no problematic attentional, behavioral, conduct, emotional, perceptual, or school attainment issues (and clearly, no SLD). She has good self-esteem but said the need to do MultiLit made her "feel dumb."

### Questionnaire Report

The Arrowsmith Program™ Cognitive Profile Questionnaire report, which remained online for several months, is displayed in Figure 1. It noted that Pseudo had difficulty with Symbol Recognition. The expected difficulties associated with this were listed as follows: "Poor word recognition, slow reading, difficulty with spelling, trouble remembering symbol patterns such as mathematical or chemical equations." The report contained an unresponsive link to enrollment possibilities at "participating schools."

### Arrowsmith Options

Alternatives to the full-day program were offered in the form of Eaton Arrowsmith (half-day), Eaton Arrowsmith (part-time), Magnussen Motor Symbol Sequencing Program Summer, Cognitive Intensive Program Summer, Cognitive Extension Program, Eaton Arrowsmith Adults (full-time), Eaton Arrowsmith Adults (part-time), Cognitive Enhancement Program for Children (part-time), and Cognitive Enhancement Program for Adults (part-time).

Some schools across Canada have embraced Arrowsmith™, which has affiliates (licensees) hosting self-contained classes in

Australia, the Cayman Islands, South Korea, Spain, Malaysia, New Zealand, Thailand, and the U.S. Arrowsmith Young maintains a strict policy that only schools that have been established for five or more years, with an enrollment of at least 100 students, are eligible to "lease" the program. A Program Coordinator is assigned to each site to offer training, support, and professional development in the Arrowsmith™ "methods and communication." Prospective Arrowsmith™ teachers undertake a three-week teacher training course that includes "a comprehensive Reference Manual and ongoing web-based professional development seminars throughout the year."

In terms of outcomes, the March 2020 Arrowsmith™ website section for frequently asked questions *(https://arrowsmithschool.org/faqs/)* indicates, "Students that we have followed up to 30 years after completion of the program have maintained their improvements. Once the improvements are in place, it is hypothesized that the individual maintains this gain by using the cognitive area in everyday functioning." There is no mention of the additional two years' experience, or the possible need for tutoring to bring schoolwork up to speed.

## The Question of Evidence

In 2018, 2019 and 2020, the Arrowsmith™ frequently asked questions page of the website read: "The Arrowsmith Program Research Team headed by Arrowsmith Program Director, Barbara Arrowsmith Young, Arrowsmith Program Executive Director, Debbie Gilmore is currently working with researchers to design and conduct studies in various disciplines, including education, psychology, and neuroscience. These studies will investigate the changes in the brain as well as academic, cognitive, emotional and social outcomes that occur for students engaged in the Arrowsmith Program. It is expected that the results of these current studies will be published in peer-reviewed journals upon completion."

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The exact content of The Arrowsmith Program™ has always been proprietary, with only approved, paying, licensed schools, and Arrowsmith™-trained teachers having access to it. It is not available, therefore, to the general public, or to independent researchers such as neuroscientists, wishing to scientifically examine it for evidence that it works. So, despite its longevity, Arrowsmith™ has not been scrutinized empirically, impartially, and rigorously for Olswang's (1998) four E's of treatment outcomes. What are its effects (what does it do?), efficacy (does it produce intended outcomes, or could change be accounted for by something else that is happening in a student's life?),

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**Based on the answers you provided, you have identified concerns in the cognitive areas that are associated with:**

**Recognizing and recalling symbols and symbol patterns.**

**Problems in this area are linked to difficulty with word recognition, spelling, remembering symbol patterns such as mathematical or chemical equations; slow reading speed. [Symbol Recognition]**

**---- Notes ---**

**For assessment and enrollment possibilities in Toronto, please visit Arrowsmith School Toronto**

**For assessment and enrollment possibilities in Peterborough, please visit Arrowsmith School Peterborough**

**To enquire about enrollment possibilities in an Arrowsmith Program, contact one of the Participating Schools**

**To learn more about the Arrowsmith Program, please visit our website**

**To gain further understanding of these cognitive functions please read Arrowsmith Program's Description of Learning Dysfunctions**

Figure 1: Arrowsmith Program™ Cognitive Profile Questionnaire report for Pseudo 12/18/18

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effectiveness (does it do what it sets out to do?), and efficiency (does it produce a result using more or less materials, equipment, time, energy, human resources, and money than competing interventions?). On the question of cost, the fees are by many standards high (e.g., *www.eatonarrowsmith.com/tuition*), and if the licensee is a private school, families pay school tuition and Arrowsmith™ fees.

Because the science of intervention for slow- or low-progress readers and children with related learning difficulties has moved on (Seidenberg, 2017) alongside neuroscience (D'Mello & Gabrieli, 2018) since Arrowsmith Young's revelations in the late 1970s, there are more questions to be asked. Has the program (or have the programs) been subject to internal development? Has Arrowsmith™ been streamlined over time such that some components were discarded, and others added in light of new research, thereby leaving the "essentials" or active ingredients of the method? What is the mechanism whereby the Arrowsmith™ exercises selectively enhance performance in discrete brain areas, thereby improving "underlying" skills, with a flow-on to academic achievement?

### Widespread Criticism

Scholars and practitioners, well-versed in evidence-based education (EBE) in teaching circles, and evidence-based practice (EBP) in clinical modalities of neurology, psychology, and speech-language pathology, have taken issue with the claims of Arrowsmith Young and other Arrowsmith™ proponents like Norman Doidge (Doidge, 2007) and Howard Eaton (Eaton, 2018). Critics claim Arrowsmith™ is unsound because its scientific rationale is wanting, is unsupported by juried research evidence, and is based on the premise that reading and other aspects of learning will be improved by working on supposed "underlying" abilities. Prominent among the many international critics are Dorothy Bishop (psychologist, see Bishop, 2015), Anne Castles, Genevieve McArthur (Castles & McArthur, 2013), and Max Coltheart (Coltheart, 2014; Jacks, 2016), Linda Siegel (cognitive psychologist; see Siegel, 2012), and Pamela Snow (cognitive psychologist and speech-language pathologist; see Snow, 2015; Bowen and Snow, 2017, pp. 234–236).

A search in March, 2020 of the Google Scholar, ProQuest Central, ProQuest Social Sciences Premium Collection, Web of Science, and Education Resource Information Center (ERIC) databases returned no papers with the term "Arrowsmith Program," or variations of it, in the title. Nonetheless, the Arrowsmith™ publicity and marketing materials refer repeatedly to "peer reviewed research" (e.g., Brainex Corporation, 2015b), "over the last several decades" (see: *https://arrowsmithschool.org/research/*) and electronic sources point to screen shots of conference posters—which is not equivalent to peer-reviewed publications. The Arrowsmith Program™ offers studies with small sample sizes of five, seven, and 15 participants, as well as in-house reports, and testimonials from satisfied consumers. Testimonials are unconvincing in intervention contexts due to inherent cherry-picking bias, the absence of accounts from *dis*-satisfied clients, the lack of a distinction between who did and did not benefit (no program has a 100% success rate) and why, or the unexpected or negative consequences for at least some recipients.

### Flawed Science

Full text of one published, peer reviewed paper by Weber and colleagues (2019) is available. They recruited 28 full-time Arrowsmith™ school students aged 9;5-to-16;8 in their first academic year of a three- or four-year Arrowsmith Program™, with an average school attendance rate of 9.2 months. Reportedly, the students had histories of "learning challenges" but there is no indication that they had confirmed diagnoses of learning disability. Of them, 9/28 performed within normative expectations in all academic domains at baseline, and 19/28 performed below age expectations on at least one measure of reading, writing, or mathematics (implying that one or some of them had measurable difficulty in just one academic domain). They completed pre- and post-intervention Woodcock-Johnson cognitive and achievement tests (McGrew, Schrank, & Woodcock, 2007) and underwent magnetic resonance imaging (MRI) within two weeks of those tests. Weber and colleagues concluded that Arrowsmith™ may be associated with improvements in cognitive and academic skills, while stressing that their results were preliminary, and analyses were mostly "exploratory" in nature.

The authors readily acknowledged that the study had limitations. The most serious deficiency was the lack of control group comparisons. This was unexpected, because in 2016 the director of the Brain Behaviour Lab where the research was conducted, wrote, "We are now planning to study a total of 90 children from three groups: 1) children with learning disabilities who are enrolled in the Arrowsmith program, 2) children with learning disabilities who are enrolled in other educational programs, and 3) typically developing children who are matched for age and sex" (Boyd, 2016).

Without controls, all the authors show are modest improvements in reading, writing and math, and no improvements in working memory and auditory processing, over the school year. The design does not allow a reader, or the researchers themselves, to determine whether gains were due to 1) Arrowsmith™; or 2) concomitant engagement with the normal curriculum (comprising academic exercises, explained above); or 3) development; this is unlikely because standard scores should adjust for age, although when the follow-up period is brief enough, sometimes a child's score can be calculated relative to the same age-band on two occasions, and then it does become an issue; or 4) a combination of all or some of these three.

There are three other issues related to the testing: potential practice effects, regression to the mean, and blinding (masking). **Practice Effects**: It is usually assumed that standardized tests are not subject to practice effects, but they often are, as they are not designed for repeated administration. **Regression to the Mean**: In statistics, regression to the mean is a phenomenon in which data even out; so, a variable that is outside the norm eventually tends to return to the norm. In other words, if

a variable is extreme the first time you measure it (in this instance, low), it will be closer to the average on the next measurement occasion. Regression to the mean is an issue for Weber et al. because they used the same pre- and post-test measures with low scores at baseline. **Blinding (masking)**: In clinical research, the term blinding refers to concealing, from one or more individuals involved in a study, which participants are assigned to a treatment group, and which are put in a control group. Its purpose is to reduce the risk of bias. Group allocation can be masked if there is a control group, but not otherwise. If the graduate research assistants who performed the tests were fully informed, they knew that the 28 students comprised a treatment group, and that they were Arrowsmith™ students, so presumably students with SLD.

Reviewing the further limitations of their study, Weber et al. noted their small sample size; the lack of additional years of longitudinal data, for analysis; and the possibility that the neuroimaging analyses may have been limited. Certain weaknesses were not mentioned in the limitations section of the report. Weber et al.'s descriptions of the exercises in the program add nothing that cannot be determined via an online search. It is unclear, therefore, to what degree the Arrowsmith™ hierarchy cooperated with the researchers, other than contributing as a donor to the Brain Behaviour Laboratory. For example, was the policy of only allowing approved, paying, licensed schools, and Arrowsmith™-trained teachers to know the content of the program, specifically *each child's* program, relaxed? Whatever the case, a reader still does not know exactly what Arrowsmith™ students must do in performing the 19 categories of exercises. Weber et al. note that the exercises are individualized for each student, but, again, with no details of 1) how the "individualization" is achieved; 2) how the 28 individualized intervention plans might differ from each other; or 3) what the 28 students practiced. Finally, because the students' intervention is not described in adequate detail, independent replication will be challenging.

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## Future Opportunities

There are longstanding ideology-versus-science differences within the education landscape among those who disagree about how children should best be taught to read, with Whole Language proponents in the ideologic corner and evidence-focused phonics proponents in the other. This notwithstanding, there is broad agreement on the centrality of the "five big ideas" of reading instruction described and recommended in the outcomes of the three (to date) national inquiries into the teaching of reading: one each in the USA (the National Reading Panel, in 2000), Australia (National Inquiry into the Teaching of Literacy; Rowe, 2005), and the UK (the Independent Review of the Teaching of Early Reading; Rose, 2006). They are vocabulary, comprehension, fluency, phonemic awareness, and phonics-based instruction (Bowen & Snow, 2017, pp. 223–225; Buckingham, Wheldall, & Wheldall, 2013). Children (and adults) with reading difficulties also need those five, in a combination that is individualized, and closely monitored for each student. The delivery should be intensive, explicitly focused on reading *per se* and not a set of disparate subskills, individualized according to expert initial and regular ongoing assessment (and not only annual assessment).

Over time, a scalable solution to the high incidence of SLD in general, and reading difficulties in particular, would begin with preservice educators (trainee teachers) having solid grounding in EBE and the five big ideas, exemplified by the Structured Literacy approach (Spear-Swerling, 2019). A focus on EBE at university and in teachers' continuing professional development activities might help teachers become more critical, information-and-research-literate consumers of the scientific literature. They would then be better equipped to discern effective literacy instruction methods, whether for typically developing children or for children and older individuals with SLD. Such teaching strategies would be grounded in high levels of evidence and have good fidelity when implemented in real-world classrooms. Teachers who are so armed are well prepared to implement evidence-based instruction themselves, across typical and atypical populations. Furthermore, they are in a strong position to guide families, colleagues, and school administrators toward appropriate, efficacious, and efficient literacy instruction methodologies for SLD populations, including low- and slow-progress readers.

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